In such cases it is of course of the greatest value to be able to examine the constitution of the bodies without affecting them chemically; and spectrochemistry, as we have seen, gives us the means of doing so. By observing the behaviour of light on its passage through the various substances, we gain an insight into their structure without in any way disturbing it.

In the last ten years the spectrochemistry of the nitrogen compounds has also made remarkable progress. Nitrogen is of the greatest importance as an essential constituent of the proteids, the alkaloids, and many other animal and vegetable products. But its high valency and the extraordinary variety of combinations into which it can enter with other elements surround it with special complications. Regardless of these, however, the spectrochemical examination of nitrogen compounds has already yielded useful results, especially in the study of the alkaloids. It is to be expected that this optical method will also be of use in the chemistry of the albuminoids, the study of which is now being prosecuted with so much vigour.

One class of substances of increasing importance both to science and to chemical industry is that constituted by the natural and artificial perfumes. An overwhelming majority of them consist of derivatives of the terpenes. We have already mentioned that Gladstone, in this subject also a pioneer, was the first to study the optical behaviour of the terpenes. Since then the explanation of the structure of these bodies and of a large number of rich natural perfumes derivable therefrom has been rendered easier by the use of spectrochemical methods. Similar assistance has been rendered to the synthetic preparation of valuable scents, such as ionone, the artificial scent of violets. In every scientific laboratory and in every rationally conducted chemical factory where work is being done on perfumes, the spectrometer is now an indispensable testing instrument, and hence also an implement in industrial production.

When scientific research opens up new methods of observing nature, it is generally not long before a use is found for these methods in practical life. The need is soon felt of perfecting, and at the same time simplifying, the scientific apparatus. Efforts in this direction have not been wanting in the case of the spectrometer, and they have been crowned with the most brilliant success.

Prof. Abbe, the distinguished physicist who died not long ago, and after him Dr. Pulfrich, constructed spectrometers on the principle of total reflection. These instruments are distinguished from those formerly in use by their extraordinary simplicity and convenience, and they allow also of much more rapid work.

Such instruments, known as total reflectometers, have been made for the most exact scientific measurements, and also for medical and technical purposes. Special forms are in use for the examination of fats and oils, milk and butter; to determine the amount of salt contained in salt solutions; the amount of alcohol and extractive matter in beer; for the examination of blood and albuminoids in pathological fluids, &c. Several of these ingeniously contrived instruments give not only the refractive index and the dispersion of a substance immediately, without any calculation, but also directly the percentage of dissolved matter, *e.g.* of alcohol and extractives in beer.

THE MIOCENE FORMATION OF MARYLAND.

WE have received from the Maryland Geological Survey a memoir on the Miocene formation of the State, in two volumes, text and plates. This is the second of a series of reports dealing with the systematic geology and palæontology of Maryland, that on the Eocene having been previously published, while reports on other formations are in progress. We may heartily congratulate the State geologist, Dr. Wm. Bullock Clark, on the appearance of these volumes, which in type and illustrations leave nothing to be desired, while the subject-matter, the result of labours extending over fifteen years, represents the combined work of field geologists and of experts in various branches of palæontology.

Of special interest is a chapter by Mr. W. H. Dall on the relations of the Miocene of Maryland to that of other regions and to the recent fauna. He points out that the differentiation of faunas in European and North American areas was well established before the beginning of the Tertiary, so that in the early stages of that epoch the faunas in the west show American characteristics clearly as compared with those of Europe. Other differences, suggesting migrations, occur in the relative time of appearance of certain groups; as, for instance, in America, the first influx of Nummulites is in the upper beds of the lower Oligocene, just as these lowly forms of life were about to disappear from the European fauna, where they had long flourished. In the history of the American Miocene there are many differences and many points of agreement with European equivalents, which are duly pointed out. As in Europe, the Miocene was a period of elevation, of plication of the earth's crust, of denudation, and of the deposition over extended areas of sediment, chiefly of clays, sands, and marls, more or less consolidated. Diatomaceous deposits also occur.

In an introduction Dr. Clark discusses the general stratigraphic relations of the Miocene deposits of Maryland, which have long been known for the rich faunas which they contain. The Oligocene is not represented, and the strata lie unconformably on the Eocene. The palæontological relations, the subdivisions and geographical distribution of the strata are dealt with by Mr. G. B. Shattuck, who gives an elaborate table showing the localities and horizons of the species. The bulk of the volume is taken up with the systematic palæontology, the results of an exhaustive study of the fauna, embracing both a critical review of the species described by previous authors, as well as descriptions of a large number of new forms. As remarked by Dr. Clark, the description of species of fossils is of little scientific importance to the geologist, unless the object is something more than the mere multiplication of new forms. In the present case the endeavour has been made to clear up doubtful points in synonymy and to give as complete an account as possible of the geological and geographical ranges of the fossils. All groups from the Mammalia to the Radiolaria, Foraminifera and plants come under notice. The higher vertebrates are dealt with by Dr. E. C. Case, the fishes by the late Dr. C. R. Eastman, many of the invertebrates by Dr. G. C. Martin, the Echinodermata by Dr. Clark, and the remaining groups by other authorities.

The palæontology is illustrated by 135 plates, while in the volume of text there are sections, numerous pictorial views, and a coloured geological map. The work is well indexed, and there is a useful geological bibliography.

MINERAL PRODUCTION OF INDIA.

AN interesting new departure has been made by the Geological Survey of India in devoting the last issue of the *Records* (vol. xxxii., part i.) to a review of the mineral production of India during the years 1898 to 1903, by Mr. T. H. Holland, F.R.S., director of the Survey. This review, which covers 118 pages, with 6 plates, compares very favourably with the statistics of many countries where the facilities of obtaining information regarding the mineral production are far greater than in India. The period covered is six years, and it is intended in future to issue quinquennial reviews. The minerals are divided into two groups:—(1) those for which fairly trustworthy returns are available, and (2) those for which definitely recurring particulars cannot be procured. It is curious to note that in the review of mineral production in India issued by Sir George Watt in 1894, four minerals, salt, coal, iron ore, and petroleum, were the only representatives of the first group, whereas it is now possible to obtain trustworthy returns of the production of thirteen minerals, coal, gold, graphite, iron ore, jadeite, magnesite, manganese ore, mica, petroleum, rubies, salt, saltpetre, and tin.

The production of salt, which was 358,000 tons in 1898 and 336,000 tons in 1903, showed considerable fluctuations during the period under review; but in the case of all other minerals there was substantial progress. The Indian coal output rose from 4,000,000 tons in 1897 to 7,500,000 tons in 1903. The production of gold steadily increased from 390,505 ounces to 603,218 ounces. The production of saltpetre also increased, the average

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annual exports having amounted to 382,000 cwt. The petroleum industry increased at a greater rate even than coal mining, the production having risen from 19,000,000 gallons in 1897 to 88,000,000 gallons in 1903. Rubies form, next to petroleum, the chief source of revenue from minerals in Burma, the value of the output having risen from 57,950*l.* to 98,575*l.* In the case of mica, India is the leading producer, and supplies half the world's consumption. The value of the mica produced in 1898 was 53,890*l.*, and in 1903 86,277*l.* The waste heaps are now turned over to supply the cheaper varieties required for the manufacture of micanite for electric insulation. The rapid development of the manganese ore industry has been very remarkable. Twelve years ago mining had hardly begun, and now more high-grade ore is produced than in any other country except Russia. The value of the output in 1898 was 27,426*l.*, whilst in 1903 it was 132,741*l.* Jadestone, which is being exported in increasing quantities to the Straits and China, with an average annual value of 44,770*l.* for the mineral exported, must be classed among the important minerals, its value being seven times that of the tin and half that of the rubies. Iron ore is mined to supply the Barakar works and the old charcoal furnaces still persisting in the more remote districts. In view of the fact that the imports of iron and steel are increasing year by year, there appear to be good grounds for utilising the abundant ore supplies by starting iron works on a large scale. During the period under review the graphite deposits of Travancore and the magnesite deposits of Salem received attention, and now form serious items in the comparatively limited markets of these minerals. Tin is more widely distributed in India than is generally recognised, and in South Burma river gravels are washed for tin with considerable commercial success.

The minerals for which statistics of production are incomplete are of a very varied nature, the list including alum and aluminium ore, amber, antimony, arsenic, asbestos, borax, building stones, chromite, clays, copper ore, corundum and other abrasives, gem stones, glass-making sands, lead, silver and zinc ores, millstones, mineral paints, mineral waters, phosphates, rare earths, slate, sodium compounds, steatite, and sulphur. It is evident that there is great scope for development in the mining of metalliferous minerals and of minerals that are needed for the more complicated chemical and metallurgical industries. This is not surprising in view of the fact that by-products are indispensable sources of profit in modern chemical and metallurgical practice; and India must continue to pay taxes on imports until industries arise demanding a sufficient number of chemical products to complete an economic cycle. Until that time, ores that will not pay to work for their metal contents alone must necessarily be neglected.

DISEASES OF FOREST TREES.

THE Board of Agriculture and Fisheries has recently issued a set of nine diagrams illustrating the diseases of forest trees. The set is composed of forty-five coloured figures. Very scant attention has been paid to this important branch of forestry in the past, and it is only within comparatively recent times that such works as those of Hartig and Sommerville, Tubeuf and Smith, Marshall Ward, Massee and others have directed attention to the importance of the study of tree diseases from a practical point of view. By such means the public has come to realise that plants, like animals, are subject to various ailments which, if not attended to, may become epidemic and cause serious loss, not only in forestry, but also in the sister industries of agriculture and horticulture. As an instance of the serious loss which may be caused by fungus disease in trees, we need only mention the larch canker fungus, which has in many cases reduced one of the most stately trees of Europe to an unsightly cripple, and is thereby responsible for the loss of many hundreds of thousands of pounds in this country alone. Its ubiquity in this country is no doubt in a large measure due to the lack of proper care in the selection of localities and proper treatment of this timber tree. This is only one of the many examples of the havoc which may be wrought by epidemics among forest trees, and in addition to this the fruit-grower, the farmer, and the gardener could also furnish parallel examples to swell the list. As we have already stated, the importance of these matters is becoming greater as scientific investigation proceeds. It is of vital importance in practice that a plant disease of any kind should be recognised in its earliest stages, as it is then in most cases capable of being stamped out. It is too late to adopt preventive measures when the presence of the disease is made known by the destruction of the crop.

The importance of the whole subject to the public in general is shown by the fact that the Board of Agriculture has issued the above valuable series of diagrams, each illustration being accompanied by a printed description on a separate sheet.

The set contains the best series we have of the diseases of forest trees, and should find a place not only in all our universities and colleges, but in every school throughout the country. It is absolutely indispensable to all foresters and to those interested in the growth and production of timber.

The price, which is one shilling per diagram, should bring the set within the reach of all.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The council of the Senate has had under its consideration an offer received from the Surveyors' Institution to provide scholarships in the university, with the object of affording facilities for the higher education of surveyors in branches of scientific knowledge cognate to their profession. The council, after consultation with the Board of Agricultural Studies, is of opinion that the offer should be gratefully accepted. The scholarships will be called "The Surveyors' Institution Scholarships"; they will be three in number, one to be awarded annually. Each scholarship will be tenable for three years, and will be of the value of 80*l.* per annum.

The general board of studies has approved the name of Mr. A. N. Whitehead for the degree of Doctor in Science.

In the mathematical tripos, part i., the senior wranglers (bracketed equal) are Mr. J. E. Littlewood and Mr. J. Mercer, both of Trinity.

Oxford.—The following have been appointed examiners in the science schools:—P. J. Kirkby (physics), D. H. Nagel (chemistry), Gustav Mann (physiology), J. G. Kerr (zoology), Robert Howden (anatomy), James Ritchie (pathology), D'Arcy Power (surgery), W. W. Fisher (preventive medicine and public health).

Decrees have been passed to authorise the expenditure of 475*l.* on extending the system of electric lighting in the university museum, to raise the total emoluments of the Wykeham professor of physics to 800*l.* a year, and to raise the salary of his demonstrator in advanced work by 100*l.* a year, so that he may take charge of the laboratory both in vacation and term time on occasions of the absence of the professor.

The honorary degree of D.Sc. has been conferred on Prof. Ray Lankester, who delivered the Romanes lecture on June 14, and the degree of D.M. on Prof. William Osler.

Only one man of science—Prof. G. H. Darwin—is included in the list of honorary degrees for the Encænia this year.

Prof. A. S. Mackenzie, professor of physics in Bryn Mawr College, has been appointed to the chair of physics in Dalhousie College.

The Senate of the University of Birmingham has decided to invite Sir Archibald Geikie, F.R.S., to deliver the Huxley lecture in 1906.

We learn from *Science* that it is announced that Harvard University has received an anonymous gift of 20,000*l.* for a museum of social ethics, and 10,000*l.* from Mr. Jacob H. Schiff, of New York, for explorations in Palestine.

An exhibition of practical work executed by students of technical classes and by candidates at the recent annual examinations of the City and Guilds of London Institute will be opened at the Imperial Institute on Wednesday, June 28, by the Right Hon. Earl Spencer.

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